DLR Project City-ATM

Demonstration of Traffic Management in Urban Airspace

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DLR

Member of AT-One

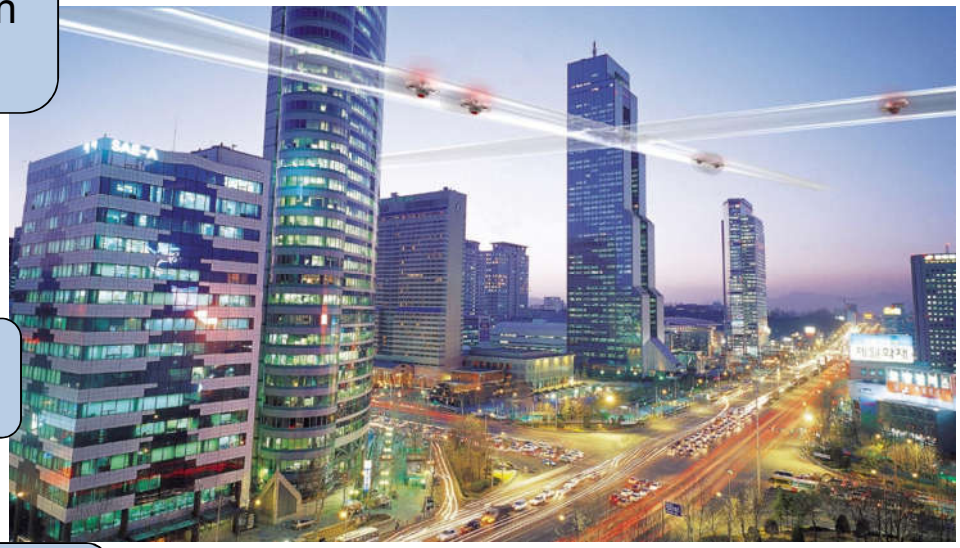
MEMBER OF SESAR JOINT UNDERTAKING

Research topics at DLR

safe, resilient und reliable communication, navigation and Surveillance

risk assessment and requirements

vehicle technologies and certification



information management

social and environmental aspects

airspace management

roles, functions and responsibilities of actors

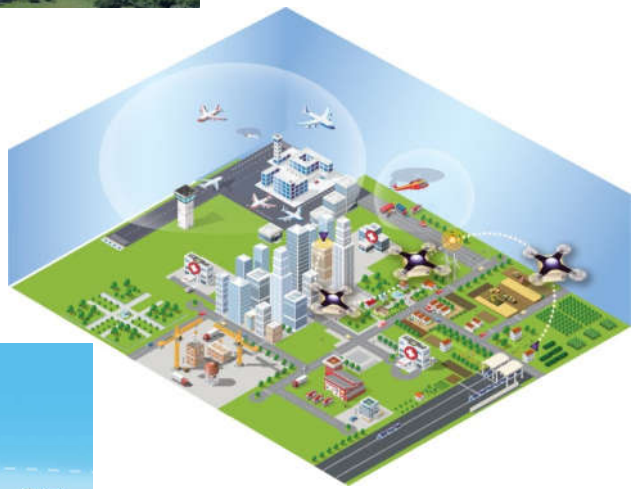
traffic management

obstacle detection and resolution

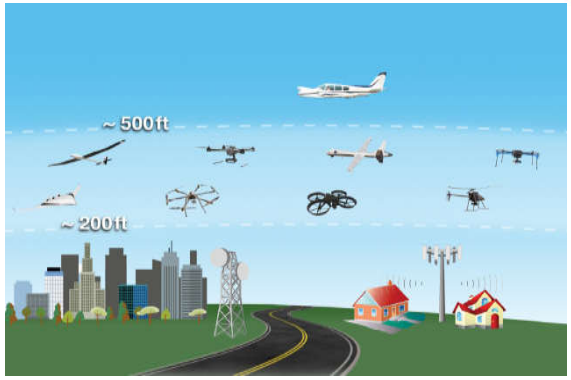
Motivation

- Various initiatives dealing with the integration of UAS and air taxis into urban airspace (below 500 ft)
- Problem:
  - no common standard
  - different application scenarios
  - several (unmanned) vehicles with differences in size, flight performance, sensors, etc.
  - safe and efficient interaction with other UAS or airspace users
  - cost efficiency vs. safety
  - Protection of privacy and critical areas, public acceptance
- Solutions:
  integration area, roles and responsibilities, requirements for vehicles

NASA UAM Project



SESAR U-Space Blueprint

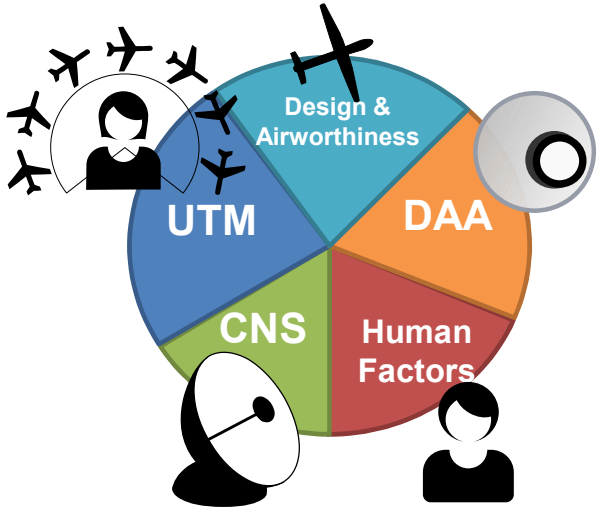


NASA UTM Project

Project City-ATM
Objectives (1)

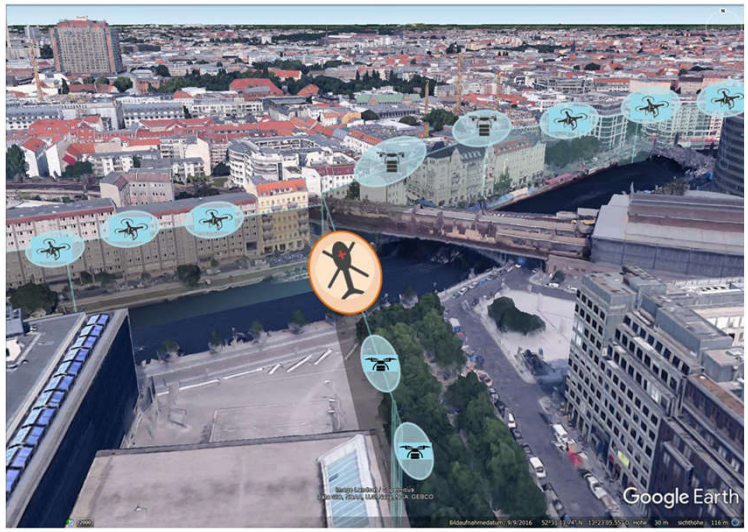
- **Development and Assessment of a City-ATM-concept (density based airspace and traffic management)**
  - Information and air traffic flow management for unmanned vehicles
  - Requirements analysis
  - Performance Based UAS Operations concept
  - CNS-concept
  - Concept of Operations (Definition of Reference scenarios)

- **Design of an open Simulation- and Demonstration platform**
  - Based on developed ATM-/CNS-CONOPS
  - Ability to integrate external UTM/UAS-System components (Stakeholder-Systems)
  - Utilization and Capacity Analysis of urban airspace (safety and efficiency)
  - Demonstration of innovative methods and technologies



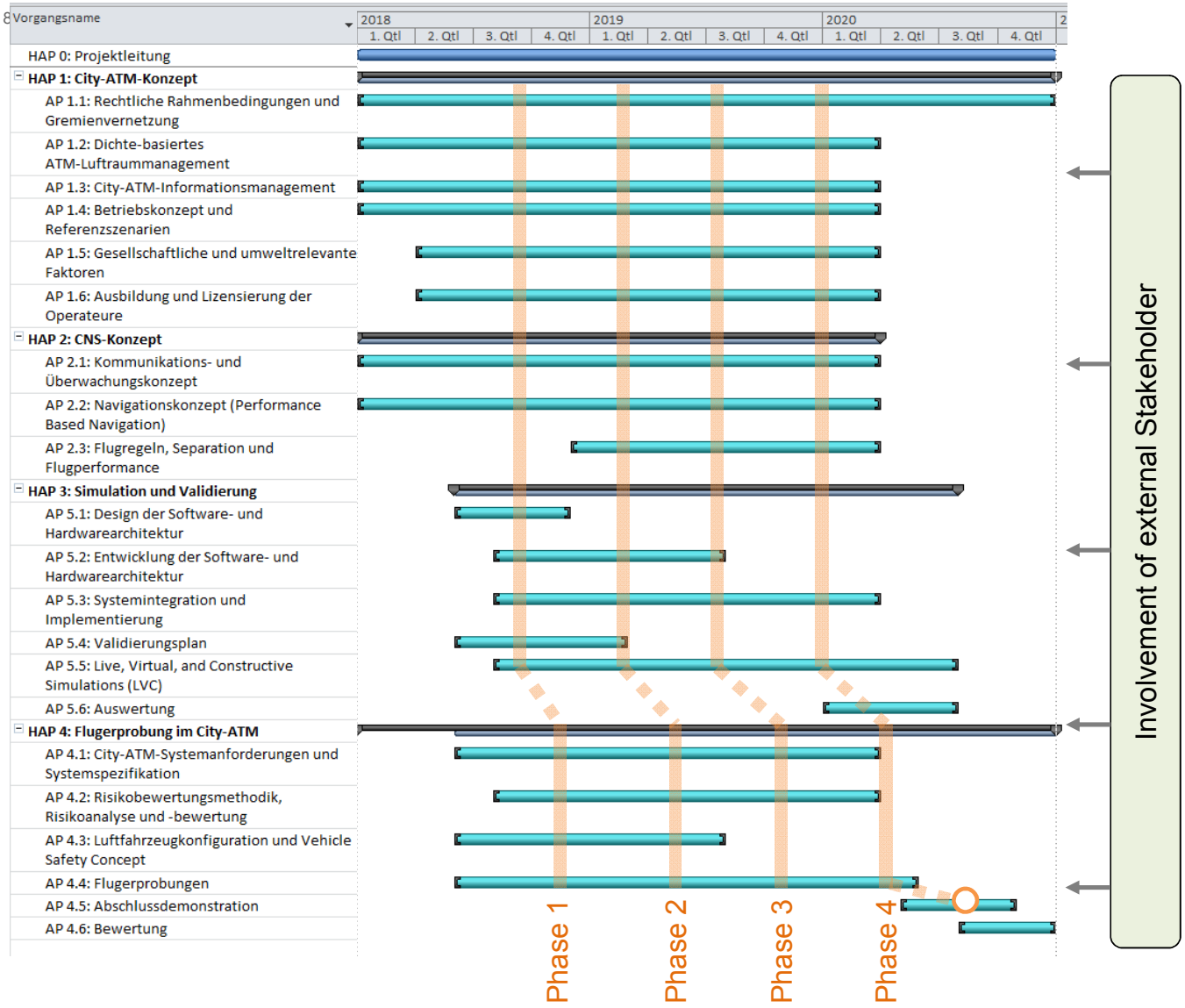
Project City-ATM
Objectives (2)

- **Development and Implementation of a UTM/CNS –Infrastructure for Flight trails in urban airspace (e.g. Braunschweig, Hamburg)**
  - Analysis of technical and operational feasibility
  - Definition of technical specifications of urban vehicles
  - Risk assessment
  - Prototypical vehicle configuration for urban Missions



Project City-ATM
Overview

- concepts, Simulations and Flight trails in different Phases with increasing complexity
- Involvement of external Stakeholder-Systems
- Early demonstration of capabilities and functionalities



Konzept-, Simulations- und Flugerprobungen in Phasen steigender Komplexität untergliedert

Project City-ATM
Overview

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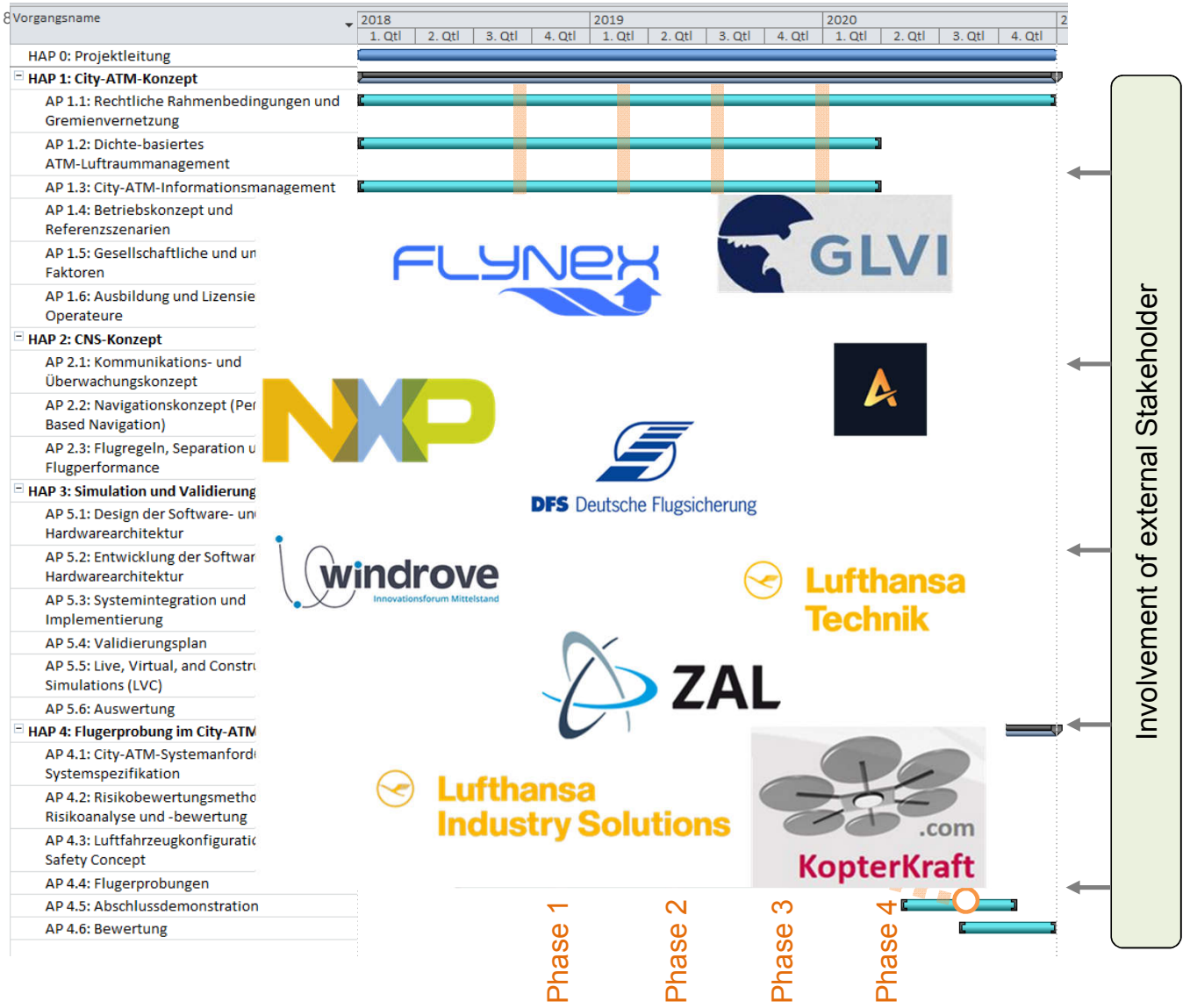


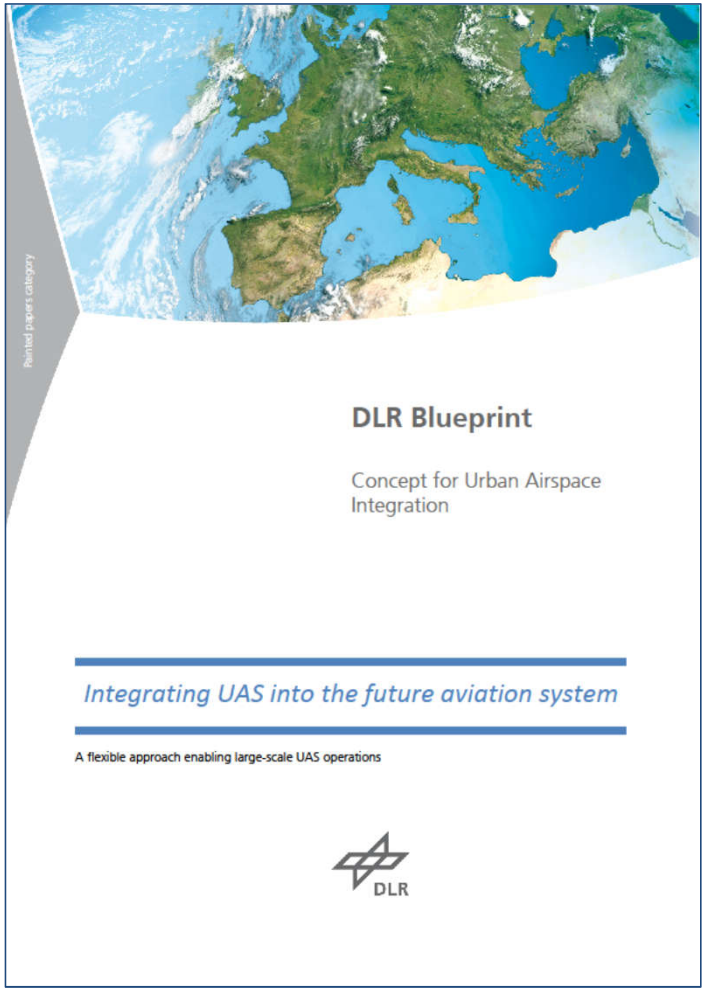
Konzept-, Simulations- und Flugerprobungen in Phasen steigender Komplexität untergliedert

U-Space and UTM
Concept

concept for urban airspace- and air traffic management

- Problem:
  - Heterogeneous vehicles of different size, flight behavior, technical abilities, flight permission and Mission objectives
  - dynamic airspace with regions of diverse requirements
- Objective:
  - Long-term „All aircraft in all airspaces“
  - Focus on uncontrolled airspace and urban areas
- Solution approach:
  - multi-dimensional Segmentation of airspace for Modeling different requirements, specific performance (UAS) and optimization of traffic planning based on density approach

DLR Blueprint „Concept for Urban Airspace Integration“



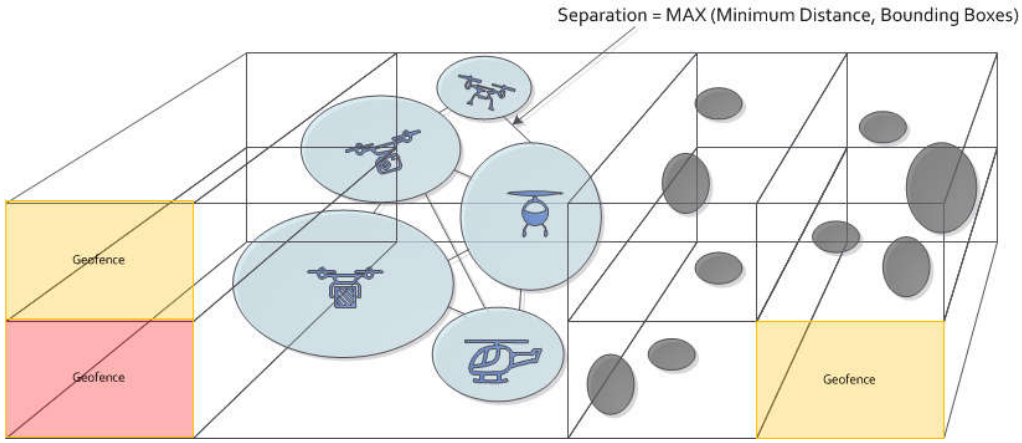
Download Blueprint: http://www.dlr.de/dlr/Portaldata/1/Resources/documents/2017/Concept_for_Urban_Airspace_Integration.pdf
More information to be presented at DASC 2018 in London

U-Space and UTM
Concept

concept for air traffic management

complex requirements:

- 3D- terrain- and obstacle maps
- static and dynamic occurring, time limited no-fly and restricted areas (=Geo-fences)
- Requirements for usage of specific airspace regions depends on performance, abilities and priorities of the user
- Actual and predicted demand for strategic air traffic and airspace management



"A lot of freedom at low density and little freedom at high density"

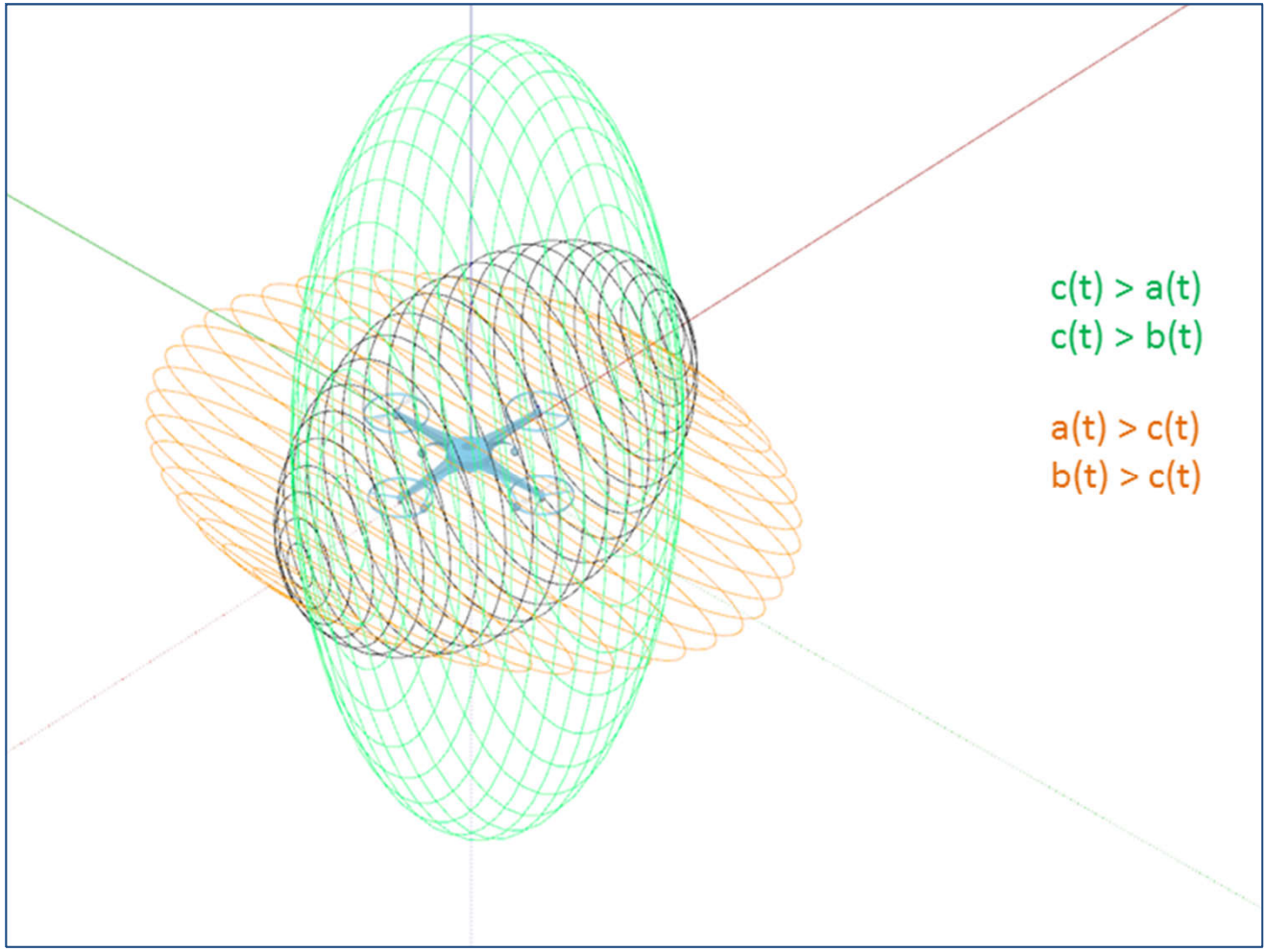
Virtual Multi-dimensional segmentation of airspace in regions of similar characteristics:

1. *3D coordinates (x, y ,z)*
2. *Temporal validity*
3. *Specific characteristics of airspace (e.g. Weather, obstacles, limited CNS-availability)*
4. *Access requirements (Navigational performance, communication and Detect & Avoid)*

U-Space and UTM
Concept

Performance Based Operations and density-based air traffic management

- Combination and Interaction of airspace users with different specifications, performance and priorities
- concept of Modelling: „***Aircraft Safety Bound"***
- Access to future airspace independent of technical specifications and individual performance of airspace users



Integration of Stakeholder

- DLR has been conducting research for several years on procedures and technologies for integration of UAS to (uncontrolled/controlled) airspace
  - Detect & Avoid
  - Performance based Operations
  - Air traffic management- and surveillance
  - Acceptance studies
  - Concept of operations and feasibility study
  - communication- and surveillance technologies (Drone2Drone, Drone2Infrastructure)
  - Vehicle configuration and Risk assessment
- Various companies with very far developed concepts and components for UAS, Infrastructure and U-Space
- **Idea: collaborative development of a safe, efficient and accepted concept and demonstrator for urban airspace**

FLYNEX
GLVI
NXP
DFS Deutsche Flugsicherung
windrove Innovationsforum Mittelstand
Lufthansa Technik
ZAL
Lufthansa Industry Solutions
.com KopterKraft

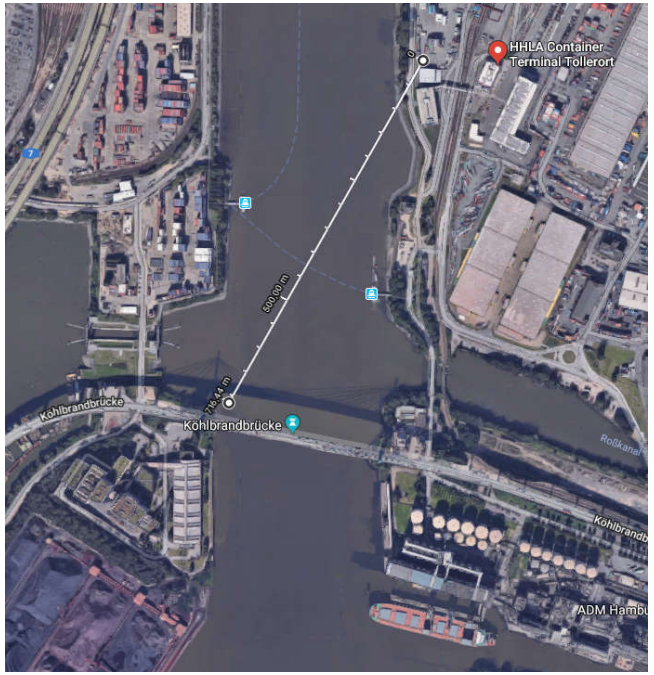
Cooperation in City-ATM

- Cooperation concept
  - DLR develops open UTM-Simulation- and Demonstration platform
  - DLR provides interfaces for integration of stakeholder-components
  - Stakeholder get the opportunity to validate and demonstrate their technologies and systems as part of City-ATM under good publicity
    - 4 test phases (Q3 2018, Q1 2019, Q3 2019, Q1 2020)
    - 1 final demonstration (Q3 2020)
  - NDA between partners ensures confidentiality

1st Stakeholder Workshop – Results

07.02.2018, DLR Braunschweig

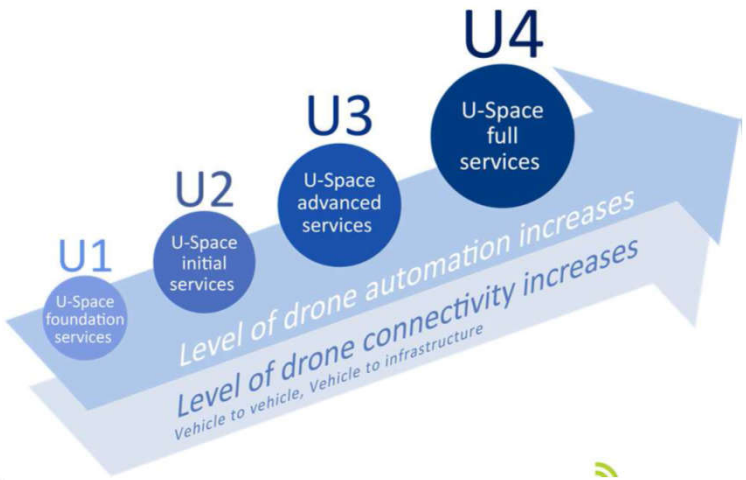
- Identification of possible Use Cases
  - Bridge Inspection
  - Tissue transport
  - Fire run
- Definition of goals for Phase 1
  - BVLOS
  - Several drones operating within a zoned area
  - Redundant surveillance and communication
- U-Space-Services for Phase 1:
  - Flight planning
  - Pre-tactical geo-fencing
  - Tracking
  - Strategic de-confliction
  - Monitoring and Traffic Info
  - E-Identification and Registration

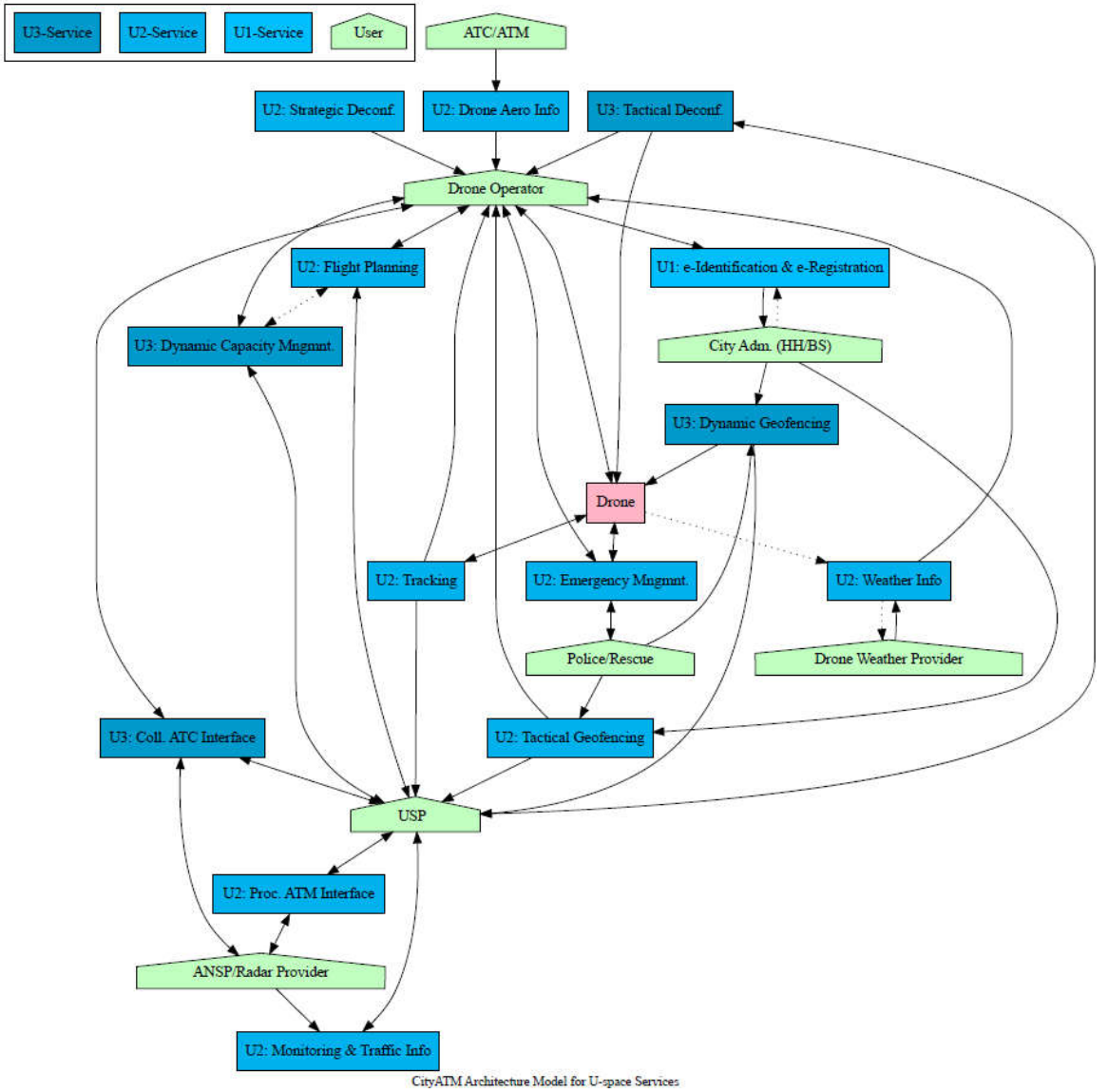


City-ATM Architecture

DLR Vision on City-ATM

- different Services per U-Space Level
- Link of Services with airspace users/system operators



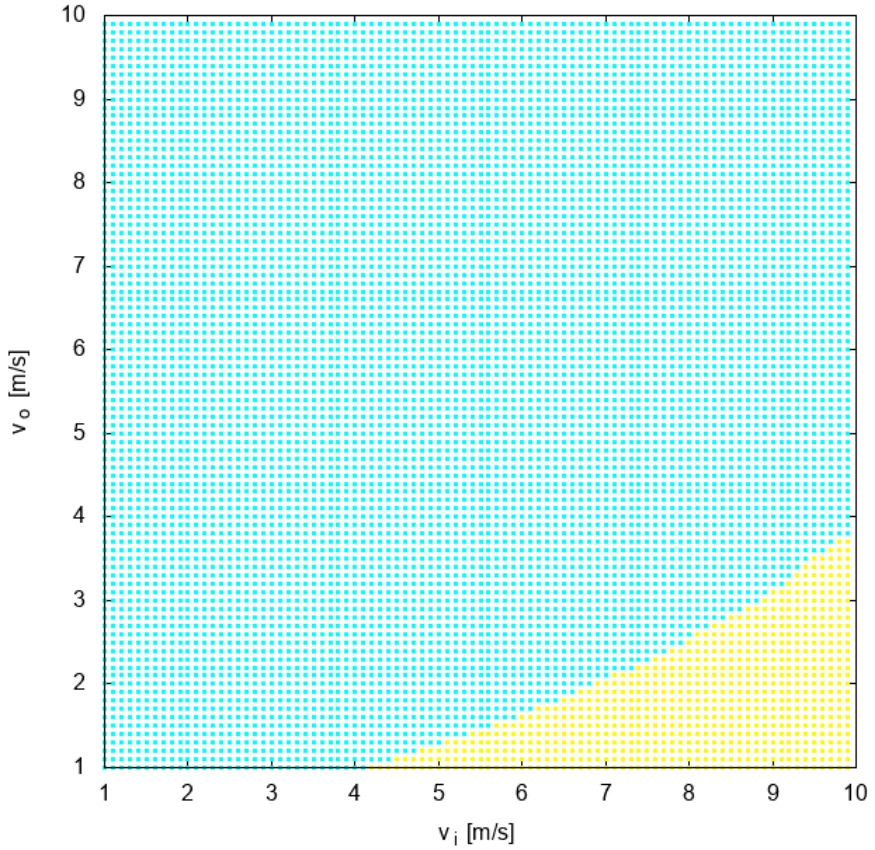


CityATM Architecture Model for U-space Services

Dichte-basiertes ATM Luftraummanagement
Separationsminima

Cyan: alles well clear (Abstand immer >20m)
Gelb: Abstand am CPA > 5m
Magenta: Abstand am CPA > 2.5m
Orange: Abstand am CPA > 1.25m
Rot: Abstand am CPA < 1.25m

3 s:



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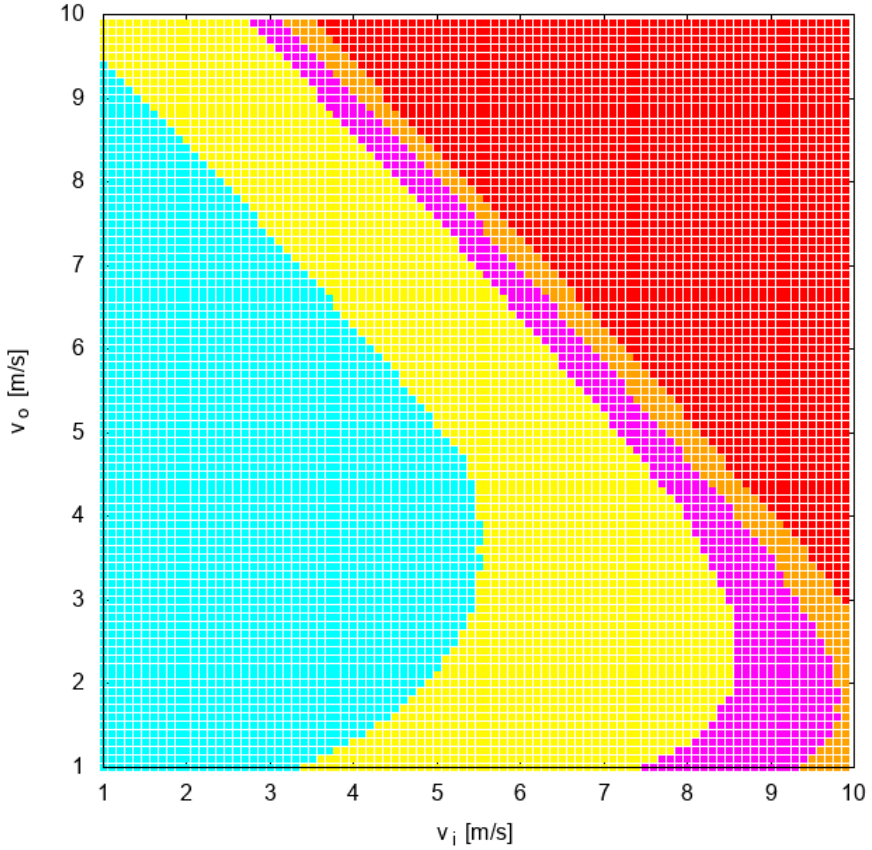
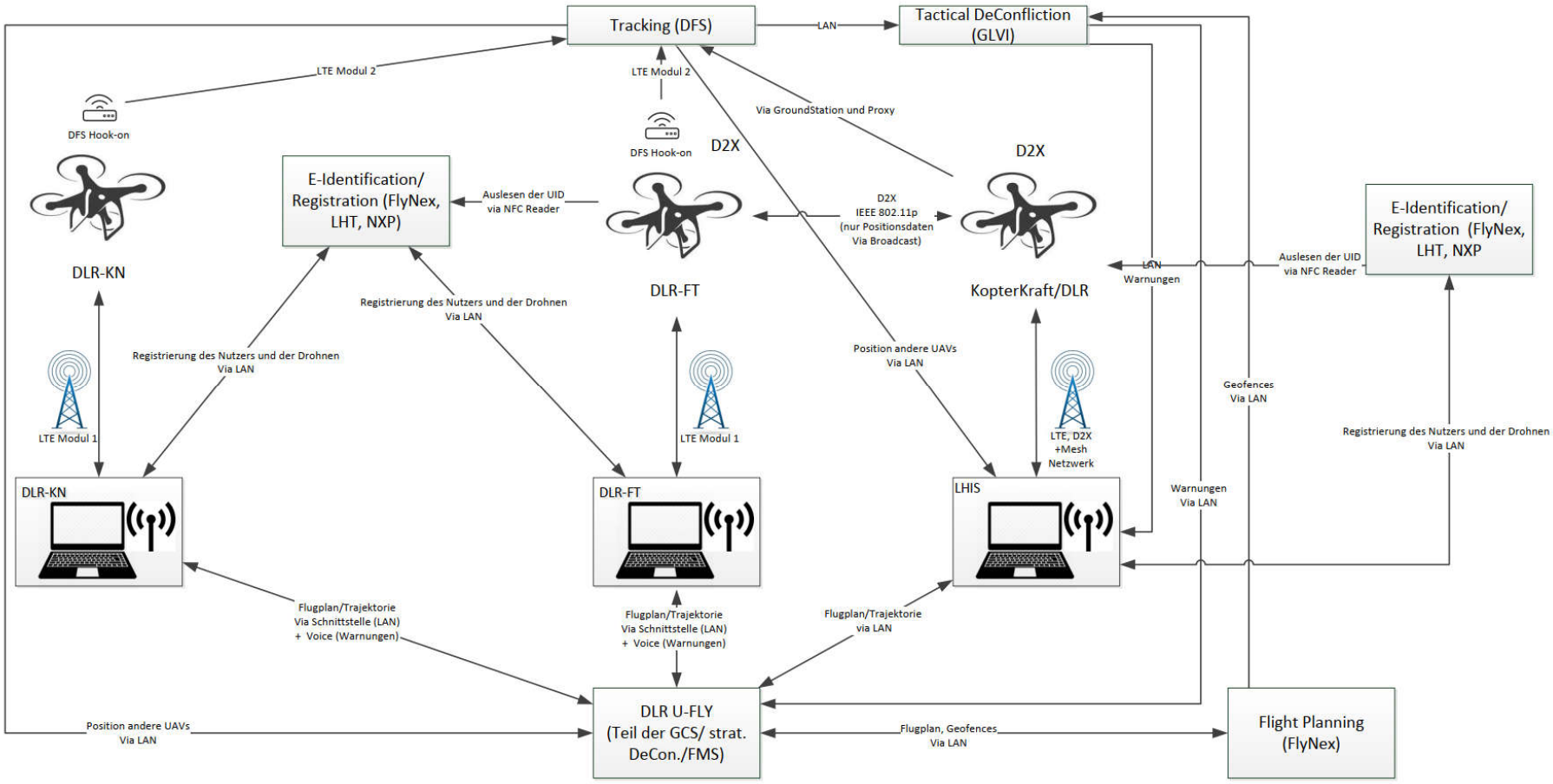
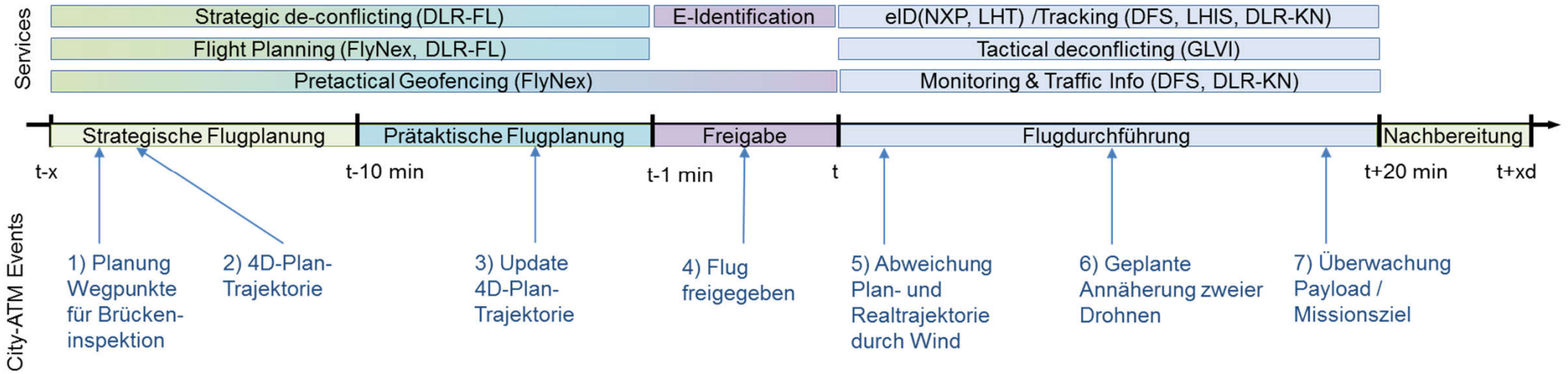


Dichte-basiertes ATM Luftraummanagement
Use case 1



City-ATM Informationsmanagement
Use-Case 1



Thank you!

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German Aerospace Center

Institute of Flight Guidance

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